

Chapter 3

Network and Internetwork



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Outline Today

Chapter 3 – Network and Internetwork

- ❖ Networking Issue for DS
- ❖ Types of Network
- ❖ Network Principles
- ❖ Internet Protocols

DS feat Internet

- **Distributed Systems (DS)** are built from a **variety of transmission media**; hardware devices; and software components.
- The collection of **hardware and software components** that provide the communication facilities for a DS as a **communication subsystem**.
- **The Internet** is a single communication subsystem providing communication between **all of the hosts that are connected to it**.

DS feat Internet

- **Interprocess communication** is at the **heart** of all DS. [**TAN'07**]
- With the **flourishing of the Internet** and the **current quick development of ecommerce**, it is very important in designing distributed systems to consider not only traditional applications but also the **requirements of distributed computing** based on the Internet. [**JIA'05**]

Networking Issues

- **Performance** :

Message transmission time = latency + length / data transfer rate

- **Scalability** : infrastructure

- **Reliability** : failure models

- **Mobility** : mobile devices and Wireless networks

- **Quality of service** : transmitting and processing streams

- **Multicasting** : one-to-many communication

Types of Network

- Personal area networks (PANs)
- Local area networks (LANs)
- Wide area networks (WANs)
- Metropolitan area networks (MANs)
- Internetworks

Wired Net.

- Wireless local area networks (WLANs)
- Wireless wide area networks (WWANs)
- Wireless metropolitan area networks (WMANs)

Wireless Net.

Types of Network

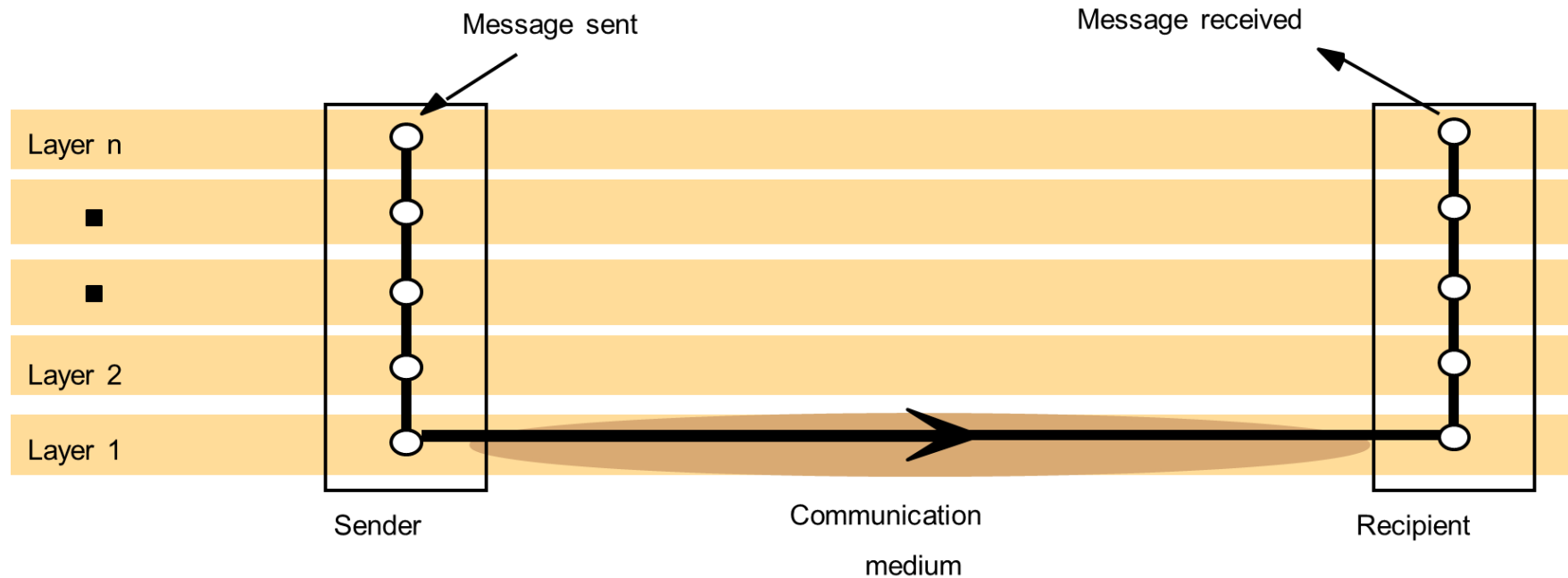
	<i>Example</i>	<i>Range</i>	<i>Bandwidth (Mbps)</i>	<i>Latency (ms)</i>
<i>Wired:</i>				
LAN	Ethernet	1–2 kms	10–10,000	1–10
WAN	IP routing	worldwide	0.010–600	100–500
MAN	ATM	2–50 kms	1–600	10
Internetwork	Internet	worldwide	0.5–600	100–500
<i>Wireless:</i>				
WPAN	Bluetooth (IEEE 802.15.1)	10–30m	0.5–2	5–20
WLAN	WiFi (IEEE 802.11)	0.15–1.5 km	11–108	5–20
WMAN	WiMAX (IEEE 802.16)	5–50 km	1.5–20	5–20
WWAN	3G phone	cell: 1–5	348–14.4	100–500

Network Principles : Switching

Here we define the four types of switching that are used in computer networking :

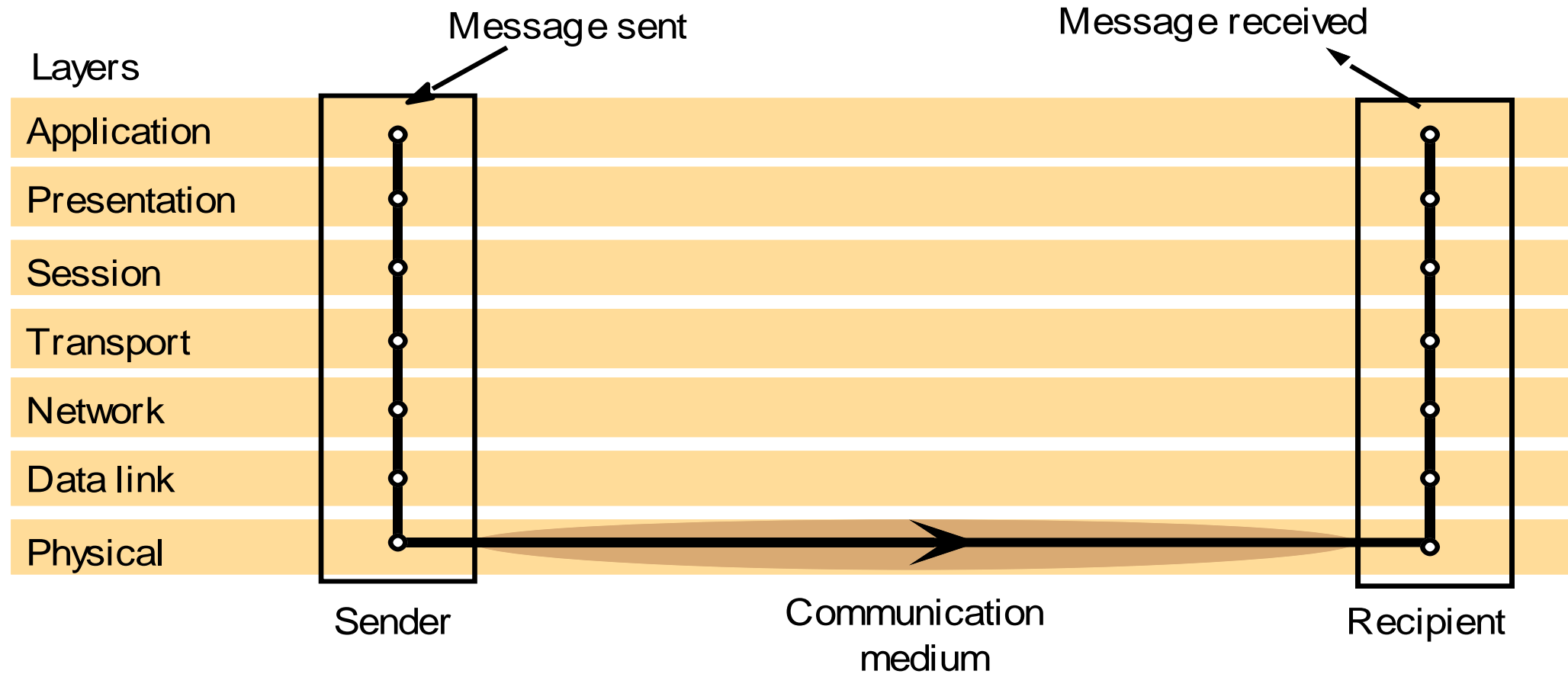
- 1) Broadcast : no switching
- 2) Circuit Switching : Telecommunication Networks
- 3) Packet Switching : Computer Network
- 4) Frame Relay : CS become PS

Network Principles : Protocols

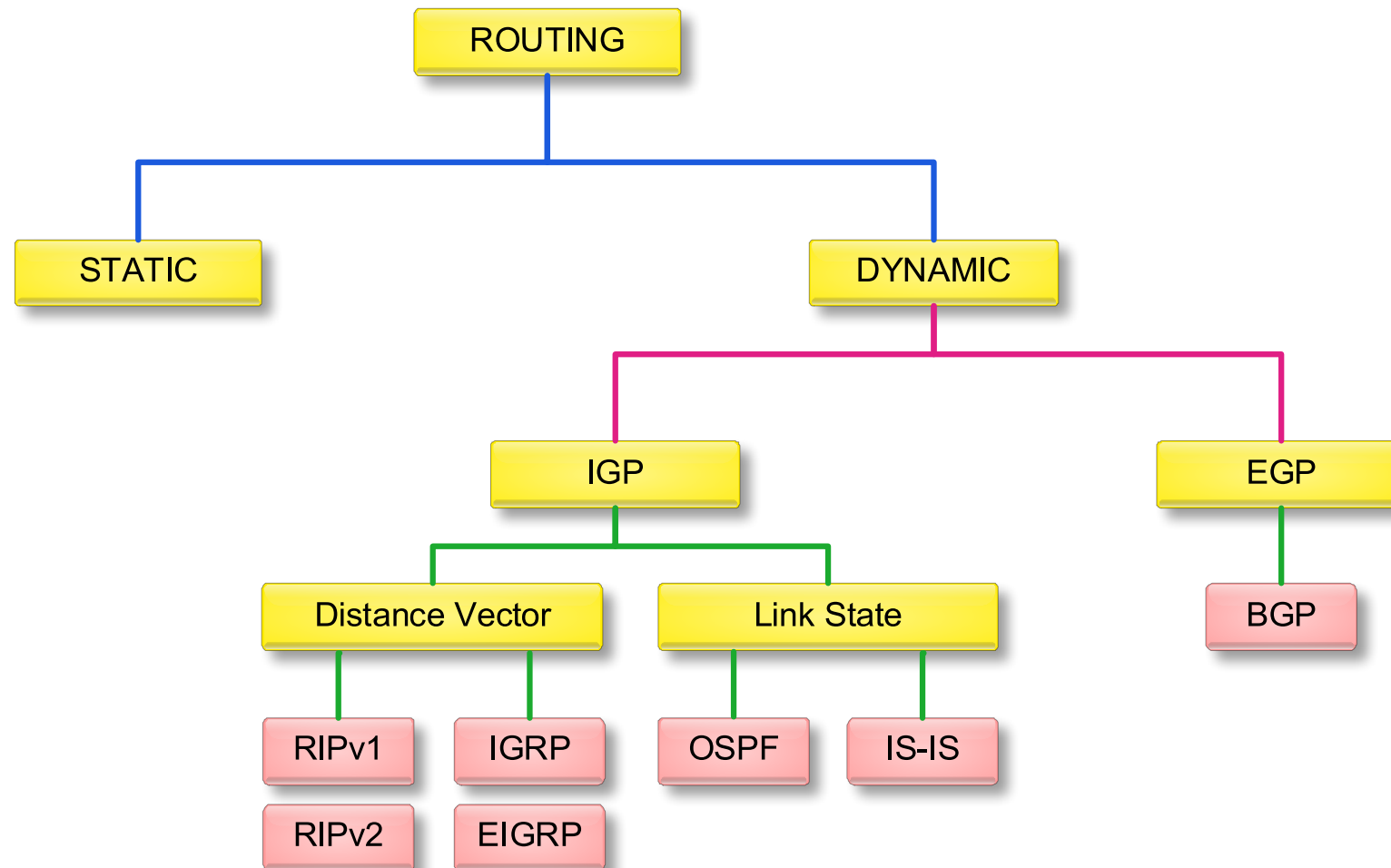


Protocols used to refer to a **well-known set of rules** and **formats to be used for communication** between processes in order to perform a given task.

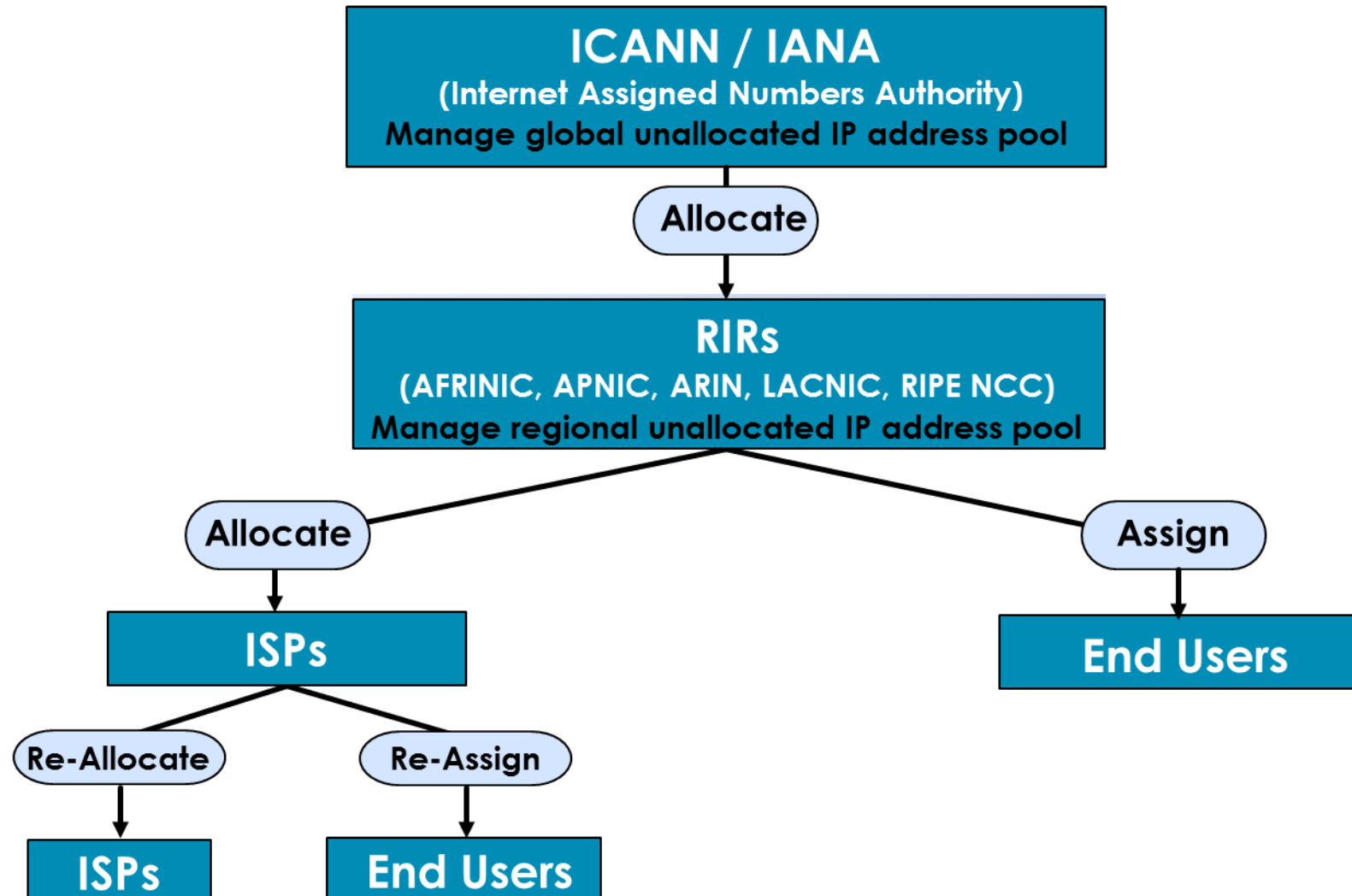
Network Principles : OSI



Network Principles : Routing Protocols



Internet Protocols : IANA

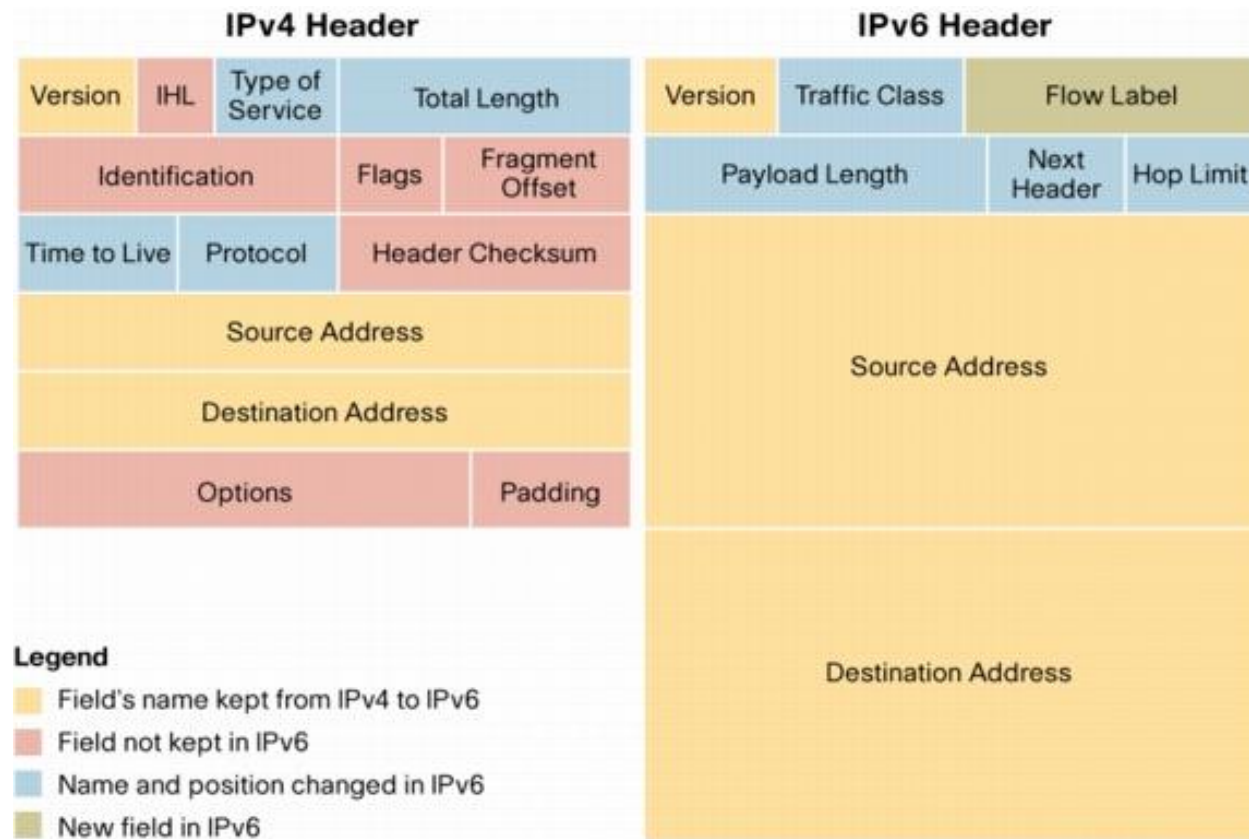


Internet Protocols : IANA



Regional Internet Registries (RIRs)
Internet Assigned Numbers Authority (IANA)

Internet Protocols : IP Address



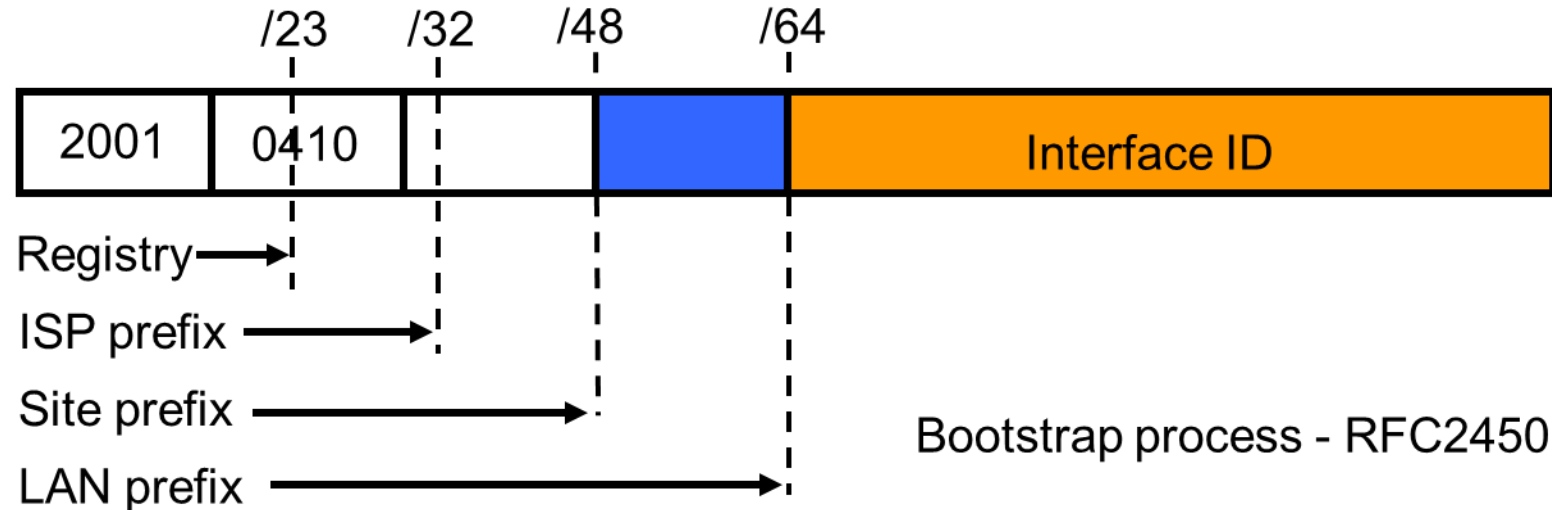
Internet Protocols : IPv4

IP Address Classes

Address Class	1st octet range (decimal)	1st octet bits (green bits do not change)	Network(N) and Host(H) parts of address	Default subnet mask (decimal and binary)	Number of possible networks and hosts per network
A	1-127**	00000000-01111111	N.H.H.H	255.0.0.0	128 nets (2^7) 16,777,214 hosts per net (2^{24-2})
B	128-191	10000000-10111111	N.N.H.H	255.255.0.0	16,384 nets (2^{14}) 65,534 hosts per net (2^{16-2})
C	192-223	11000000-11011111	N.N.N.H	255.255.255.0	2,097,150 nets (2^{21}) 254 hosts per net (2^{8-2})
D	224-239	11100000-11101111	NA (multicast)		
E	240-255	11110000-11111111	NA (experimental)		

** All zeros (0) and all ones (1) are invalid hosts addresses.

Internet Protocols : IPv6



The allocation process is under reviewed by the Registries:

- ✓ IANA allocates 2001::/16 to registries
- ✓ Each registry gets a /23 prefix from IANA
- ✓ Formely, all ISP were getting a /35
- ✓ With the new policy, Registry allocates a /32 prefix to an IPv6 ISP
- ✓ Then the ISP allocates a /48 prefix to each customer (or potentially /64)

Internet Protocols : IPv4 → IPv6

A wide range of techniques have been identified and implemented, basically falling into three categories:

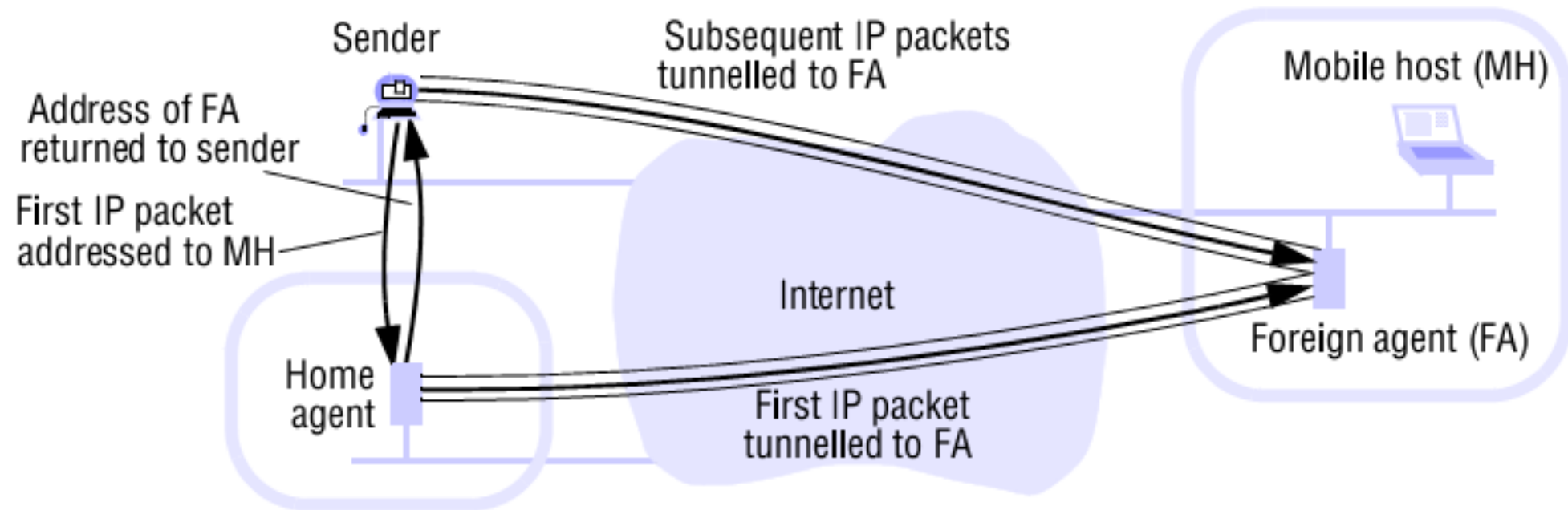
- (1) **dual-stack** techniques, to allow IPv4 and IPv6 to co-exist in the same devices and networks
- (2) **tunneling** techniques, to avoid order dependencies when upgrading hosts, routers, or regions
- (3) **translation** techniques, to allow IPv6-only devices to communicate with IPv4-only devices

Expect all of these to be used, in combination

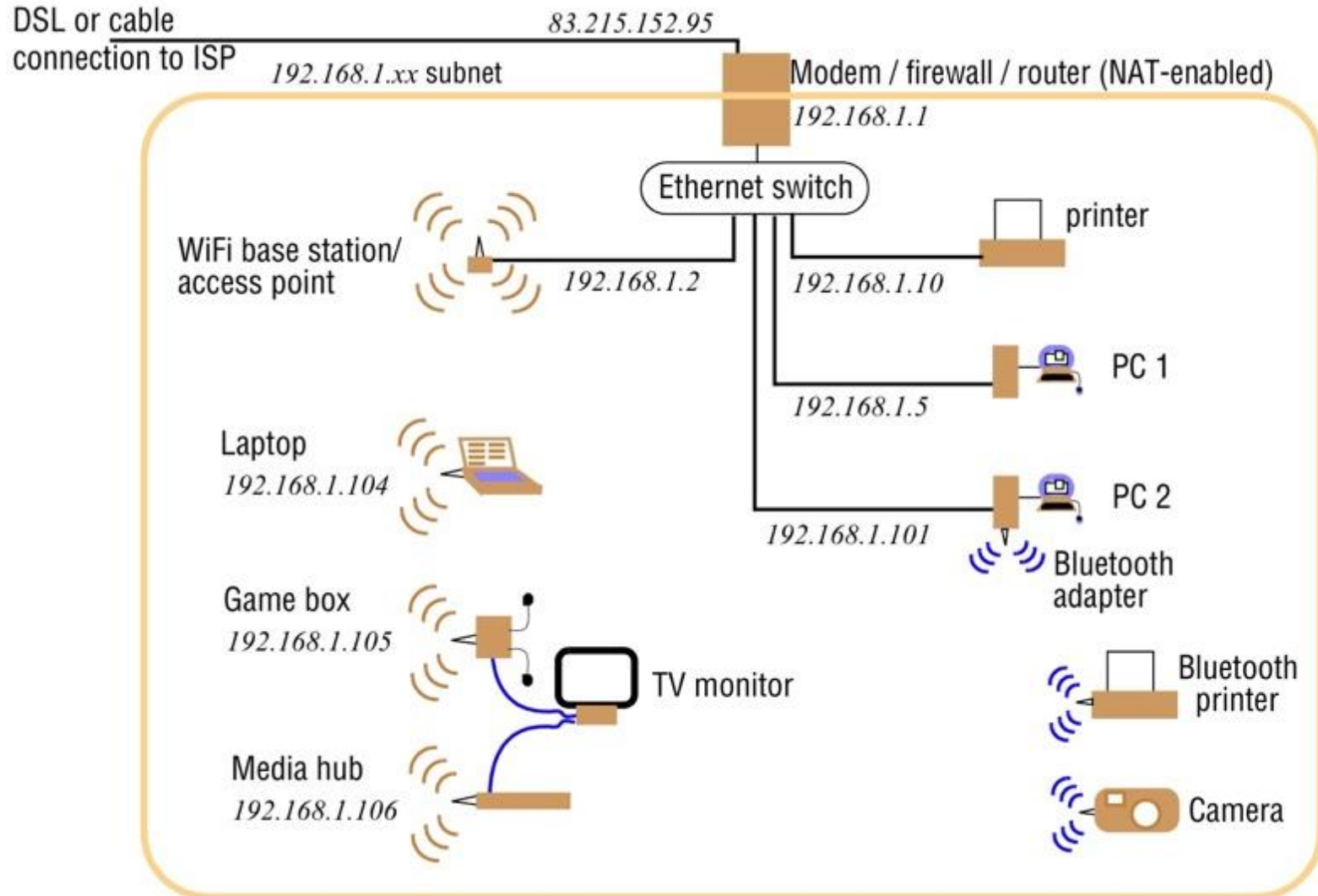
Internet Protocols : Mobile IP

- ❖ If a **mobile computer** is to remain accessible to clients and resource-sharing applications when it moves between local networks and wireless networks, it must retain a single IP number, but IP routing is subnet-based.
- ❖ **Mobile IP** is a solution for the latter problem.
- ❖ The solution is implemented transparently, so IP communication **continues normally** when a mobile host computer moves between subnets at **different locations**.

Internet Protocols : Mobile IP



Internet Protocols : NAT



Case Study : IEEE 802.XX

<i>IEEE No.</i>	<i>Name</i>	<i>Title</i>	<i>Reference</i>
802.3	Ethernet	CSMA/CD Networks (Ethernet)	[IEEE 1985a]
802.4		Token Bus Networks	[IEEE 1985b]
802.5		Token Ring Networks	[IEEE 1985c]
802.6		Metropolitan Area Networks	[IEEE 1994]
802.11	WiFi	Wireless Local Area Networks	[IEEE 1999]
802.15.1	Bluetooth	Wireless Personal Area Networks	[IEEE 2002]
802.15.4	ZigBee	Wireless Sensor Networks	[IEEE 2003]
802.16	WiMAX	Wireless Metropolitan Area Networks	[IEEE 2004a]

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Thank You



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